

RECENT STUDIES IN WEAK- FIELD ION CYCLOTRON RESONANCE IN WATER

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- The author acknowledges his collaborators:
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- **S Grimaldi, A Lisi, M Ledda** CNR (Rome)
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INTRODUCTION

- Since 1985, when the Ion Cyclotron Resonance (ICR) concept was first introduced at a NATO meeting in Erice, there have been dozens of reports showing that weak magnetic-field ICR exposures can greatly affect biological function in a wide variety of model systems.
- Despite the large body of experimental evidence in support of this idea, no reasonable explanation has yet been offered for this effect.
- All of the experimental evidence to date has been based on the specific stimulation and subsequent activity of various cations (Ca^{2+} , K^{+} , Mg^{2+} , glu^{+} ,...) in biological systems.
- In the following we report on apparent ICR effects in pure water, establishing the fact that weak-field ICR is a physical phenomenon, not restricted to biological systems.

REMARKABLE NEW ICR FINDINGS, ALL INVOLVING PURE WATER, NO BIOLOGY

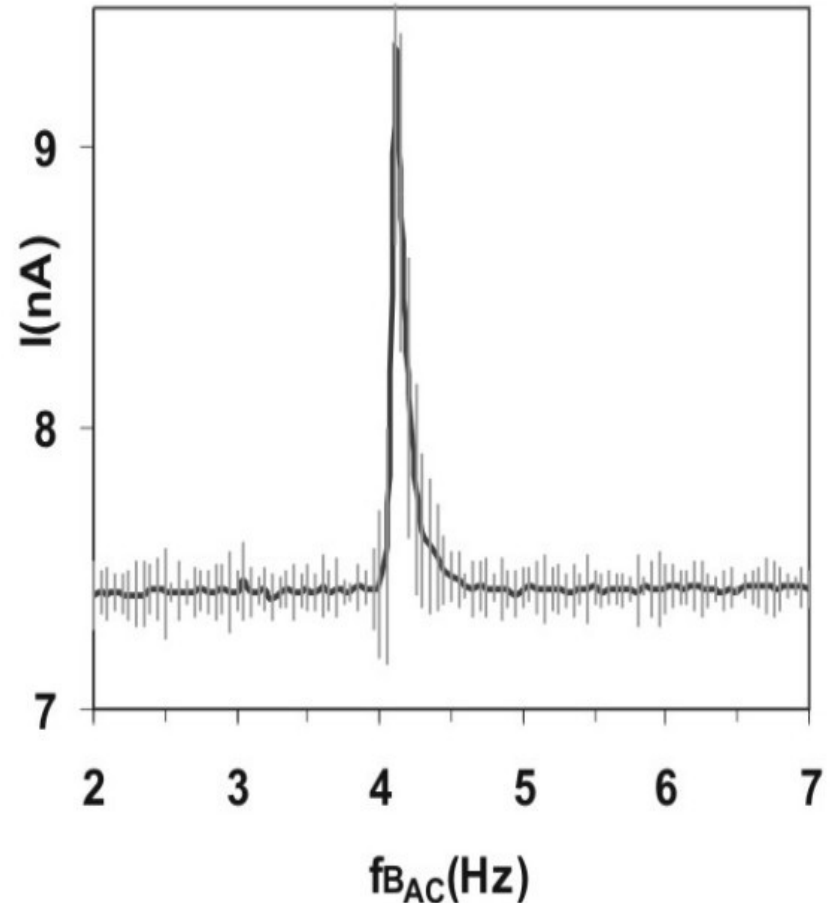
- ULTRA-LOW magnetic intensities more effective
- HYDRONIUM ICR resonance especially effective
- Change in conductivity & pH, at hydronium ICR
- GROTTHAUS mechanism (proton-hopping) involved
- SPONTANEOUS EM oscillations observed
- HYDRONIUM ICR initiates (helical?) water structure

WHY ARE WEAK INTENSITIES MUCH MORE EFFECTIVE?

- Zhadin found polar amino acids are ICR sensitive, even at AC intensities as low as 40 nT. Most recently Grimaldi in Rome, using a specially built room with background 1-10 nT discovered large ICR effects on hydronium ions in pure water, confirming earlier work by Mohri and by Sheykina.

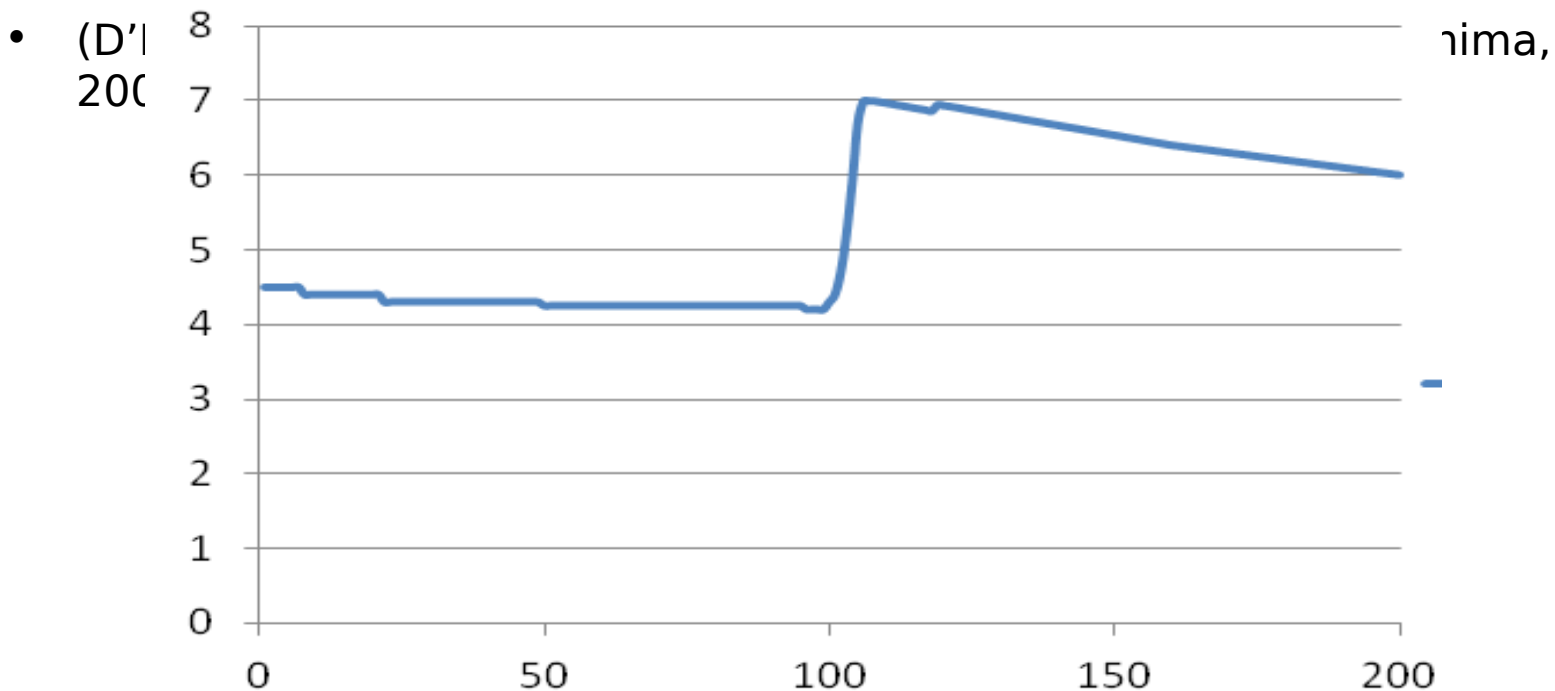
- On the right: typical ICR result (Pazur) confirming what Zhadin observed for glu^+ . $B_{\text{DC}} = 40 \mu\text{T}$, $B_{\text{AC}} = 50 \text{ nT}$. Frequency resolution is 0.05 Hz.

- See also Alberto et al, EBM, 27: 25-39 (2008)



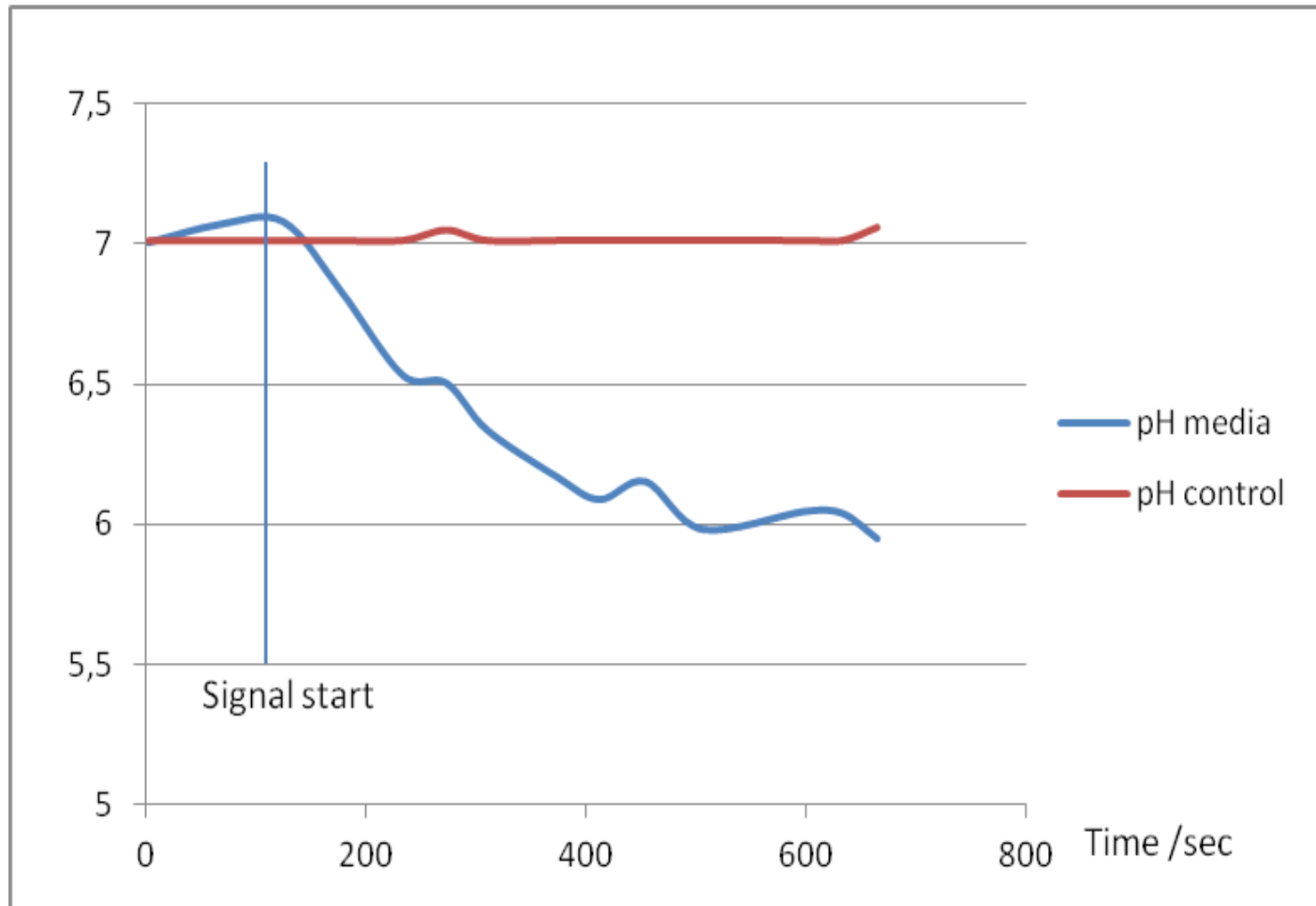
HYDRONIUM ICR AFFECTS BOTH WATER CONDUCTIVITY AND pH

- Conductivity change shown below in units of 10^{-5} S vs time. ICR tuning condition for H_3O^+ is applied at 100 s.



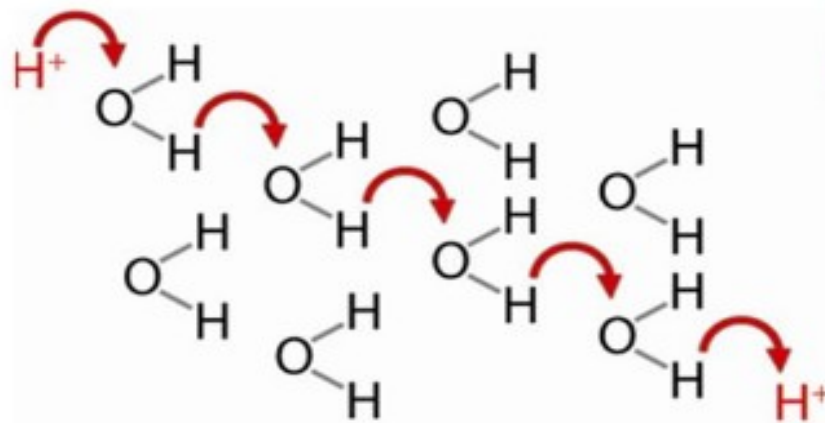
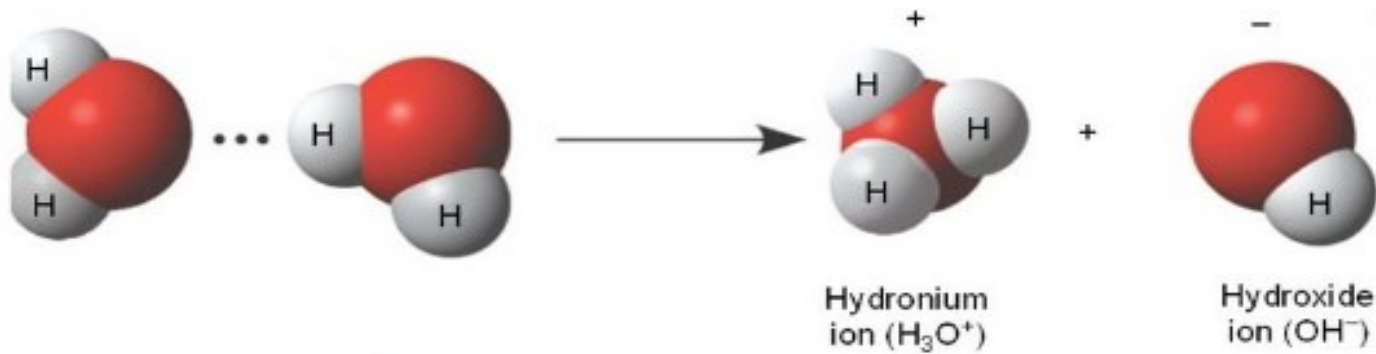
H_3O^+ ICR ALSO RESULTS IN LARGE pH CHANGE

(D'Emilia et al, EBM, 34:370-375, 2015).



H_3O^+ ICR RESONANCE IMPLIES GROTTHAUS PROTON-HOPPING

- Proton-hopping moves protons as water ionizes



PROTON HOPPING

- This may finally clear up an old problem--- how does ICR work in biofluids where conductivities are not great?
- Proton hopping in water is characterized by high conductivity. Are the rapid ICR motions of previously studied ions such as Ca^{2+} , Mg^{2+} , K^{+} , glu^{+} , ... somehow connected to proton hopping?
- An interesting finale in search of a scenario.

H₃O⁺ ICR IN WATER RESULTS IN SHORT-LIVED ELECTROMAGNETIC EMISSION

- Two well-documented observations:

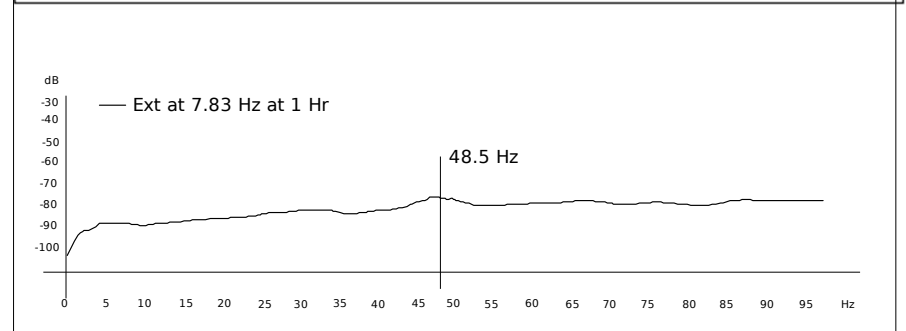
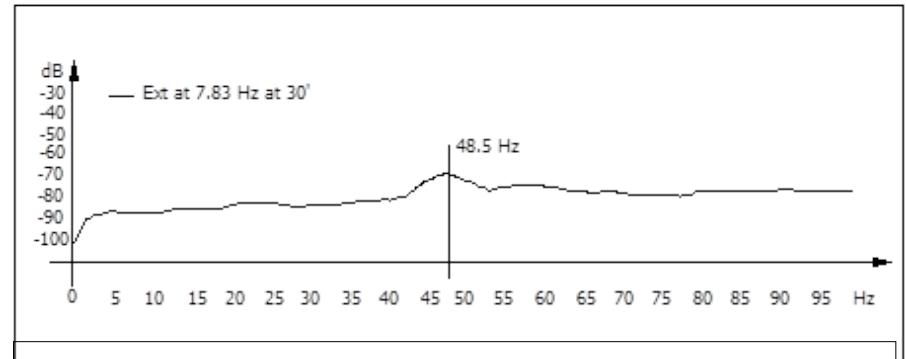
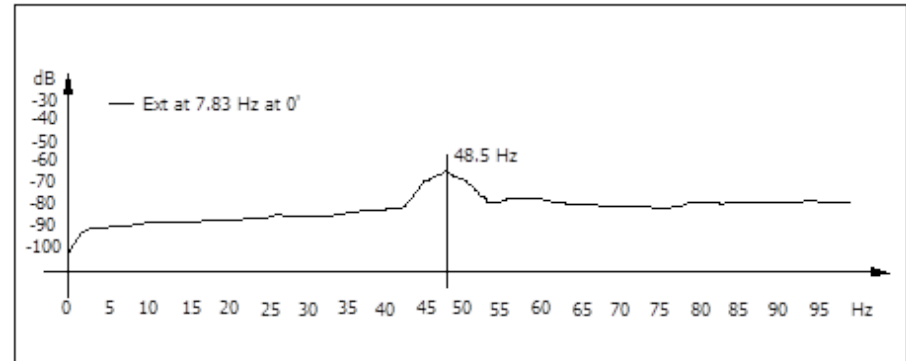
Fesenko & Gluvstein FEBS Letts 367: 53-55. (1995).

D'Emilia et al EBM 34: 370-375 (2015)

- In both cases low-frequency emission (~ 50 Hz) was observed **after** electromagnetic stimulation of water was turned off, with emission lasting for approximately one hour. Russians applied RF and measured electric oscillations, Italians applied ELF and measured magnetic oscillations.

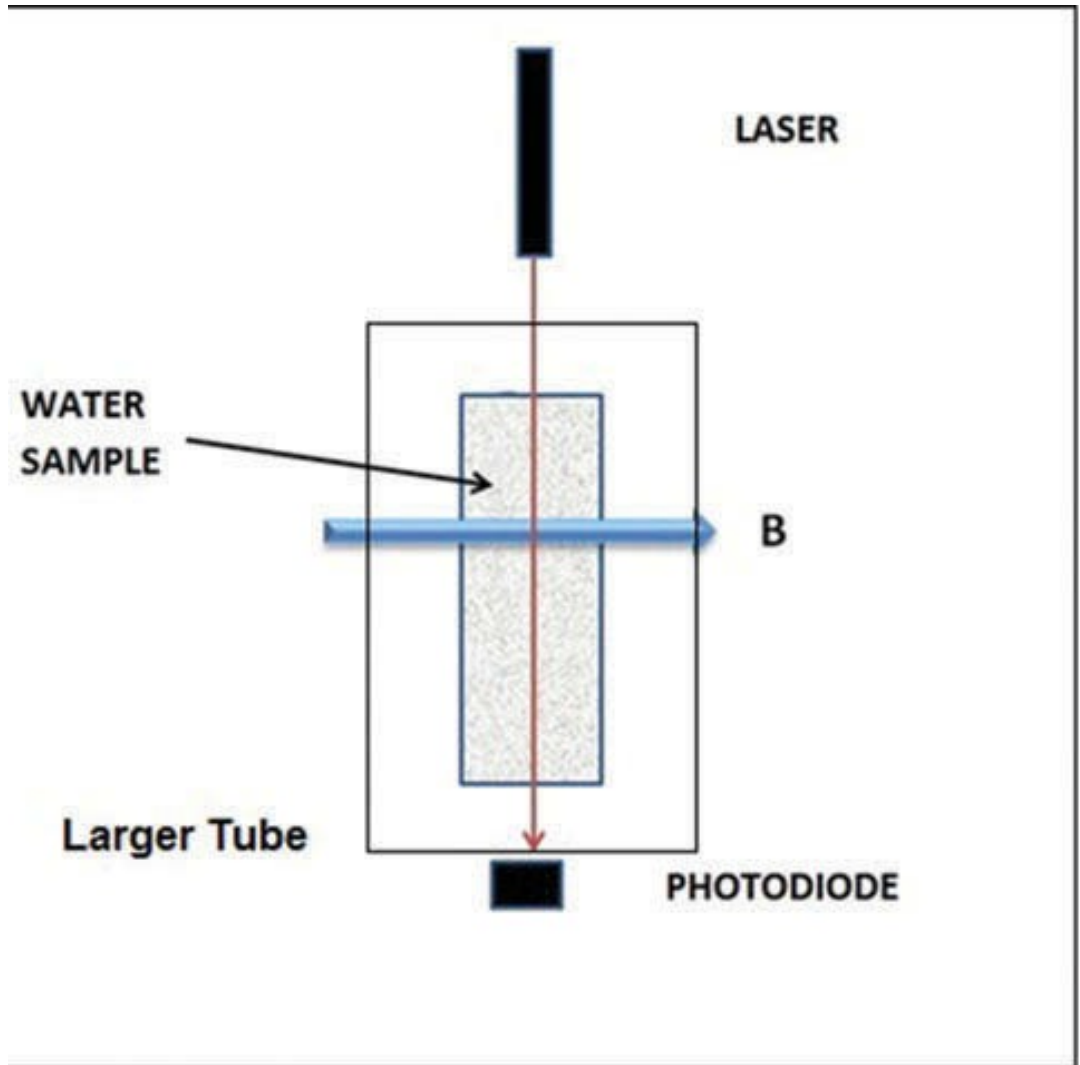
WATER EMITTING 48.5 Hz MAGNETIC FIELD, (D'Emilia et al 2015 CNR, Rome)

- Immediately after removing ICR field
- 30 minutes later
- One hour later

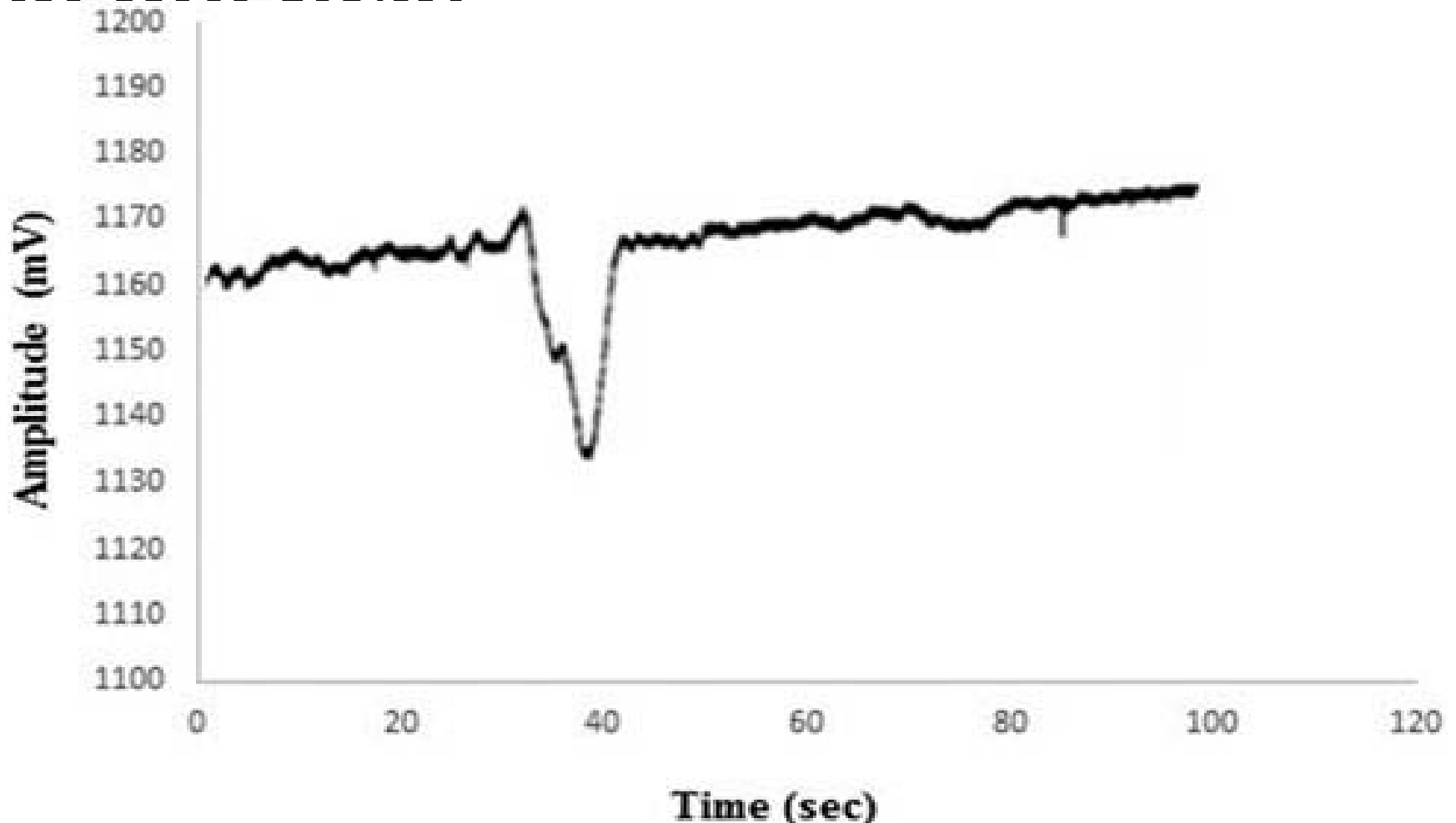


EXPERIMENTAL METHOD

Laser beam through water is deflected when magnetic field B corresponds to hydronium ICR resonance. This deflection means that index of refraction is altered at ICR frequency, which in turn means that hydronium ICR changes the water structure.

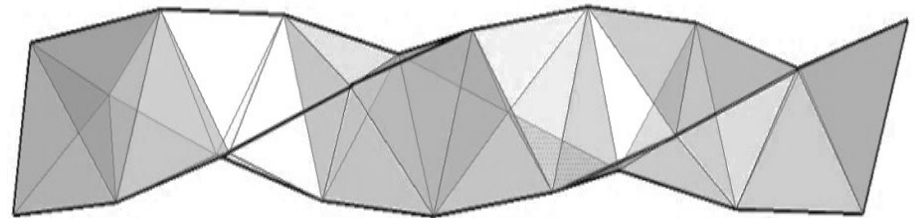
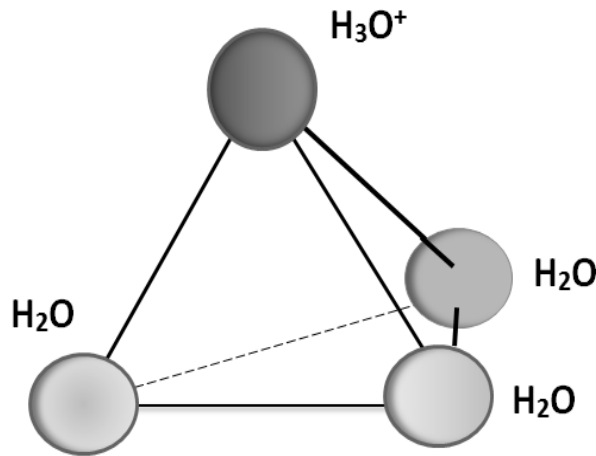


AT H_3O^+ ICR FREQUENCY APPEARS AS ABSORPTION (TIME UNITS SHOW INCREASING FREQUENCY)



HYPOTHETICAL WATER STRUCTURE DUE TO ICR EXPOSURE

We have proposed (Liboff et al, EBM, 2016) a helitetrahedral structure consisting of tetrahedra joined together in long helical chains corresponding to the Bc mathematical form:



HELICAL PATHWAY CONSISTENT WITH OBSERVATIONS

- Proton-hopping readily occurs in proposed structure, but in helical paths instead of linearly.
- Proton oscillations along helical pathways are easy to imagine in proposed structure; can explain oscillatory E- and B-fields observed in Puschino and in Rome.
- Proton-hopping may help provide an answer to the ICR puzzle---how is biologically relevant information transferred to the biological system in the ICR process? Proton-hopping may be the reason.

WHY DOES THE B-FIELD HAVE TO BE SO SMALL TO SEE THESE EFFECTS IN WATER?

- This is not a trivial question. Vanishingly small magnetic intensities are required---for example, the ultra shielded room in Rome where the background B-field is 1-10 nT.
- Why would nature make such a requirement for humans who live in a field that is roughly 10,000 times greater?
- The answer may be that it is not the ultrasmall B-field that is critical, but rather the E-field. In other words the relevant biologically important variable is the equivalent electric field ICR value.
- We examined this question previously (Liboff 2009, EBM 28:124-134) finding that the E-field equivalent to $B = 10 \text{ nT}$ is $E = 4 \text{ nV/m}$, a number, which although small, may still be possible in biological systems, even in environments with large ambient B-fields.

REVIEWING...

- It is now clear that water is highly sensitive to ICR magnetic fields
- The ion in water most easily resonated is hydronium (H_3O^+)
- Exposures result in pH decreasing and conductivity increasing
- ELF (~ 50 Hz) short-lived EM oscillations also observed
- Proton-hopping undoubtedly occurs as part of this process.
- Strong evidence that resonance also changes water structure
- New helical water structure proposed to explain these events
- The electric-field ICR value, equivalent to the usual B-field ICR, may be the more operative criterion at ultrasmall intensities.

ARE THESE OBSERVATIONS WELLNESS/CLINICALLY RELEVANT?

- Yes, for the following reasons...
- All biological tissues contain water. Consider the possibility that all the many previous successful ICR applications in biology were actually completely dependent on water
- It was suggested by Szent-Gyorgy many years ago that water may play an important role in biological function.
- These findings may be particularly significant at the BIO/AQUA interface, where electromagnetic signaling between water and life is still mysterious, and the subject of considerable discussion. See, for example, del Giudice's coherent domains and Pollack's EZ water.
- The most interesting possibility is that this may lead to new ways of applying resonant electromagnetic signals to wellness and clinical problems. We think this will happen.



**Grazie per
l'attenzione**